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HANDLING BARNYARD MANURE IN EASTERN PENNSYLVANIA

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BARNYARD MANURE is handled with special care and excellent results by farmers in certain parts of Eastern Pennsylvania. For over a century it has been the custom in this region to store stable manure in a walled manure yard, partly or wholly covered, in which the stabled animals are allowed to exercise during the day. Manure thrown into such a yard and thoroughly tramped by stock loses much less through heating and leaching than does manure piled in the open.

This bulletin describes the manure-yard method of handling manure and outlines the farm practices of ten successful farmers who follow this method.

HANDLING BARNYARD MANURE IN EASTERN PENNSYLVANIA.

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THE IMPORTANCE of securing the greatest possible return from the manure supply of the country can hardly be overestimated at any time. It is infinitely greater when the production of food is so vital to the Nation as during the present crisis.

It is well known that there is a great difference in the methods of management of barnyard manure on individual farms in the same locality and that the best yields are usually found where it is given the best care. Greater contrasts exist between different localities and, as a rule, where the methods of handling manure are best, yields are highest. In this connection excellent results have been obtained by the farmers in certain portions of eastern Pennsylvania. Ten Chester County farms in particular afford unusually good examples of efficiency in handling manure. (See Table I.)

TABLE I.—Yields of corn, wheat, oats, and hay in 1912, in Pennsylvania, compared with 378 farms in Chester County, and 10 farms selected as exemplifying the methods described in this bulletin.

Crop.	Average yields per acre in 1912 for—		
	State of Pennsylvania.	378 Chester County farms.	10 selected Chester County farms.
Corn.....bushels..	42.50	65.3	85.50
Wheat.....do.....	18.00	24.8	29.75
Oats.....do.....	33.10	41.6	a 45.00
Hay.....tons..	1.43	1.3	2.65

a Only 3 of the 10 farms grew oats.

The averages for the State as a whole are very much lower than those for 378 Chester County farms, while the averages for the 10 farms selected as exemplifying a high degree of efficiency in the

handling of manure are in some cases nearly 100 per cent above the State averages. The comparatively high yields obtained in Chester County or the exceptional yields obtained on the 10 farms cited in the table are not attributable altogether to the way in which manure is handled. The soil of Chester County is doubtless better than the average for the State, and the standard of farm management higher. But special attention to manure is a prominent feature of the system of farm management under which these high yields are obtained.

THE BARN.

The typical barn of this region is a "bank barn"—also known locally as a "Swiss barn," or as a "Pennsylvania overhang barn."

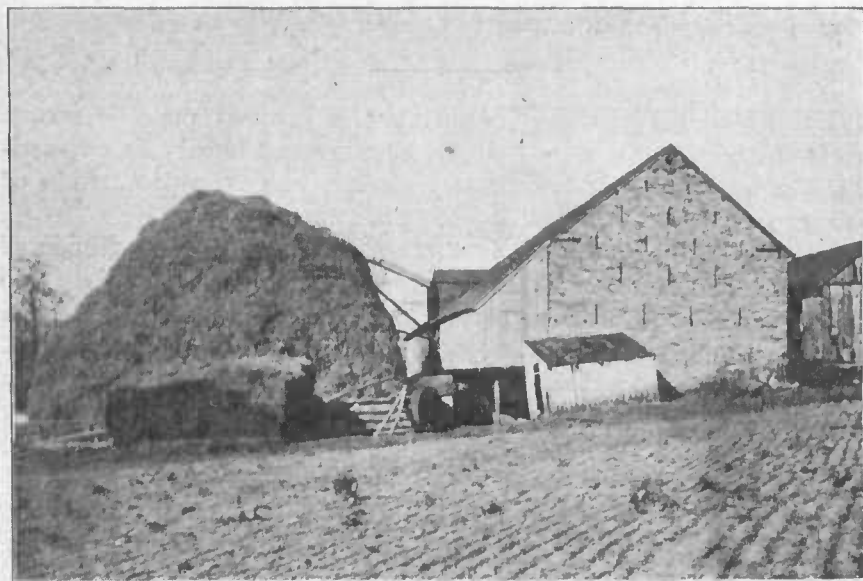


FIG. 1.—A typical stone barn of the older type.

This has been the standard type of barn for southeastern Pennsylvania for over a century. A farmer of Chester County, writing to relatives in England in 1796, says of the barns of that day:

Some take the side of a hill; they dig a large cellar—one side comes out level with the ground—some 50, some 60 feet, and some more in length, and from 40 to 50 feet in breadth. The first story is to put their dung in, the second for stabling horses, cattle, etc. Above this they build a barn about 21–22 feet high to the square over the whole, for storing their hay and grain. They have strong floors under the stables, with racks and mangers in each stable, and a trapdoor under the manger, which they raise and shovel the dung, which falls below. These barns are built of stone, with lime, and they that have tried it say the dung rotted under cover is much better.¹

¹ History of Chester County, Pennsylvania. Futhy and Cope.

The ordinary barn of this section is now seldom built of stone, as formerly, but is a frame structure built on a stone foundation, which also serves as the retaining wall of the excavation which forms the basement or cellar. The stables are located almost entirely in the basement, the floor above being the thrashing floor, used also for storing hay, grain, and other feed, fertilizer, etc. As a general rule the stables are so laid out that they open into an area called the "overhang" or "overshot," about 10 to 15 feet wide along the whole front of the barn where the basement floor comes out even with the surface of the ground. Frequently the stables do not occupy all the space back of the overhang, in which case it is usually left open, giving additional room for the stock to run.



FIG. 2.—Interior view of covered yard showing characteristic masonry piers used in building these barns.

THE BARNYARD.

Another feature of these barns is the barnyard, or "manure yard," as it is sometimes called. This is a plat of ground immediately adjacent to the overhang of the barn and into which the basement of the barn opens. It is usually surrounded by a stone wall and may be anywhere between 30 and 100 feet square in area. The wall joins the foundation of the barn, is usually about 6 to 8 feet high and about 18 inches thick, with one or two gates for driving in and out of while removing the manure, etc. This wall is generally kept in good repair and is protected on top by a cover of boards, flagstones, or concrete, to prevent the rain from seeping down into the mortar. (See illustration on title page.) A stone wall, besides being more durable than a wooden fence, keeps the manure from being blown or washed away and protects the stock from winter winds.

The ground floor of the barnyard is usually hollowed out in the center to prevent the liquid manure from escaping and is sometimes paved with flagstones. Vents are provided in the lower side wall to allow surplus water to run off after heavy rains. In some cases pits are provided to catch the liquid manure.

Most barnyards have more or less covering in addition to the overhang. These coverings consist of hay or straw lofts, some built over one or both sides of the yard or covering it completely.

That it is maintained and kept in repair indicates that the wall is still recognized as having some value. That labor was more plentiful when most of these were built than it has been during recent years

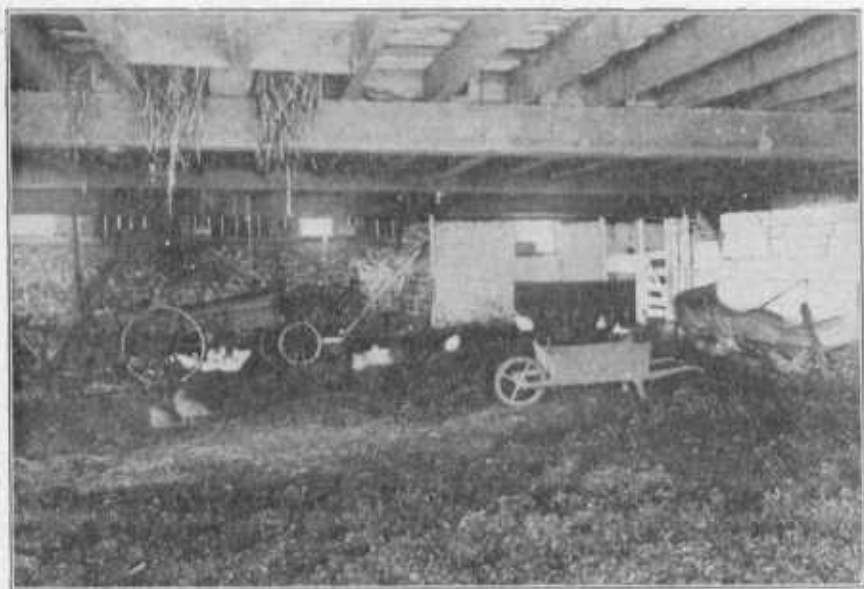


FIG. 3.—Interior view of covered yard, companion picture of Fig. 2, showing other side of yard. Note water trough, stable door, and holes through which hay and straw are thrown from the loft.

may be observed from the fact that the existing walls are largely built out of stone which was quarried on the farm or in the locality, and many of the old quarries may still be seen showing the same kind of stone as that in the walls. It is also noticeable that in some cases, at least, repairs are now made of concrete instead of stone and mortar.

Under present conditions stone is not economical for building the walls of such a manure yard except in localities where surface stone is abundant and easily available. Elsewhere concrete will be found to be by far the best material for the purpose. A tight board fence, while not durable, would answer the purpose fairly well in

cases in which it is inexpedient to build a permanent wall. Good results are obtained in many localities by inclosing manure yards with wooden fences.

CARE OF LIVE STOCK.

Generally the stock are housed during the entire winter. During the day the cattle are turned out into the barnyard. The length of time that they are allowed to stay out depends upon the severity of the weather and the degree of shelter afforded by the wall and covered portion of the yard. Where the shelter is complete, the

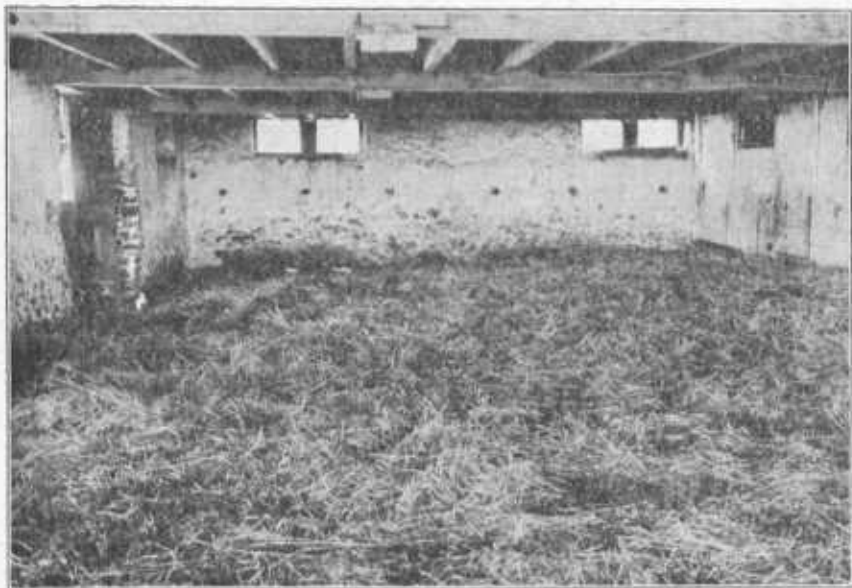


FIG. 4.—Interior view of an entirely covered yard. The manure here is 2 to 2½ feet deep.

stock, even the dairy cows, may stay out all day. The main difficulty with respect to the completely covered yards is the matter of light, as under these conditions the cattle are in semi-darkness during the entire winter. The feeding usually is done in the stable, which is kept well bedded with straw and refuse from the mangers. During the latter part of April or the fore part of May, depending on the season, the cattle are turned out to pasture, where they remain until cold weather begins in the fall, except in the case of the cows, which are in the stable each day only long enough to be fed and milked. Hogs are seldom housed at all in summer, while sheep are usually shut up at night as a protection against dogs.

CARE OF MANURE.

Nearly all manure produced on the farm accumulates in the manure yard. The largest part of it comes from the stables and is distributed in the covered portion.

All cornstalks, straw, and other roughage not used as bedding are added as needed to take up excess liquids. In this way the covered portion of the barnyard not only affords a dry and comfortable shelter for the live stock during the winter months, but it protects the manure so that no leaching occurs. In some instances the corn fodder is run through a cutter, which increases its power of absorption and makes the manure easier to handle. The tramping of the stock packs the manure so that an even temperature is obtained, which seems to favor proper fermentation, as is evidenced partly by the strong odor of ammonia which pervades the atmosphere in the vicinity when the manure is being removed, and partly by absence of dry combustion, or "firefang," so common in manure piles exposed to the weather.

Occasionally a farmer is found who sprinkles land plaster on the manure at intervals, the amount ranging from 1 to 2 tons a year, applied at the rate of a bushel a week. Disintegrated feldspar rock, common in the vicinity, has been used with good effect, but as a general thing the manure is not treated with chemical fertilizers. Some farmers turn the manure several times, but the practice is not common, and is not recommended.¹

When the barnyard is only partly covered, manure is dropped in the open space or dragged out from under cover by the animals' feet, and this portion of it is subject to more or less deterioration through leaching and lack of proper bacterial action. Even in such cases, however, the percentage of loss is not large. An estimate made on 400 farms of all types in 1912 indicated that 68 per cent of all available manure was handled by the farmer. To this must be added that dropped in the fields or pasture during the summer months, which should raise the total saved to close to 90 per cent. Farms on which

¹ In this connection it may be stated that the above methods are in accord with approved practices of the European countries, judging by the following summary of a statement from Stutzer, a German authority on the subject of barnyard manure, which says:

"Fresh manure, especially where straw or similar material has been used for bedding, contains a great deal of carbonaceous material, such as starch, cellulose, and the like, which is decomposed by many kinds of bacteria. It happens that those bacteria that destroy nitrates require an abundance of food of this kind. Nitrate-destroying bacteria are abundant in the soil. It is therefore highly important that before manure is applied to the soil it should be properly fermented in order that before nitrate formation in it becomes active the carbohydrates, cellulose, etc., should be fermented out of it.

"Both experiment and farm experience have shown that the best results with manure are obtained by keeping it under cover and well tramped and sufficiently moist to permit bacterial activity in it for a few months before spreading it on the fields. Where it is necessary to put fresh, unfermented manure on the land, the best plan is to spread it on late in the fall and then disk it in or plow it in shallow in order to mix some soil with it, so that the carbohydrates and cellulose may be largely broken down before active nitrate formation begins with warm weather in the spring."

barnyards are completely covered save practically all of the manure except that dropped by the animals in waste places while going to and from the fields.

One farmer whose yields are exceptionally high, keeps no cows, except for family use. He builds manure piles consisting of alternate layers of cornstalks, horse manure, and spent manure from the mushroom beds, and obtains excellent results.

KEEPING UP MANURE SUPPLY.

For many years dairying has been the principal type of farming in this section. Recently, however, a steady decrease has taken place in the number of cows kept for dairy purposes, owing to the scarcity of labor and other economic conditions. Yet there is no sign of a decrease in the yield of crops. Instead, the habit of using manure seems to be as strong among these farmers as when dairying was more extensively practiced.

To keep up the manure supply, some farmers are feeding steers, some keep enough cows for the family use, and increase the complement of hogs, sheep, and poultry. In one case hog raising has become the most important enterprise on the farm. Scores of farmers have gone into the mushroom business, in which large quantities of horse manure from New York and other cities are used each year. When this manure has served its purpose in the mushroom beds, it is thrown out and used as a top dressing on the fields or in composting with other manures on the farm. In this way some farms are now getting more manure than they formerly did under the dairy system, while the cropping system remains practically the same as before.

CROPPING SYSTEMS.

The cropping systems followed in this region are based on the old, fundamental rotation practices followed so extensively over the northern half of the United States and in Canada, namely, corn, small grain, and clover. Most of the crops grown are fed on the farms. The crops most generally sold are wheat, and some corn and hay. Most farmers maintain a permanent bluegrass pasture in addition to the rotation area.

The prevailing rotation now followed on the farms of the region is:

First year-----Corn.

Second year-----Corn for grain, ensilage corn, or both, oats, and potatoes.

Third year-----Wheat.

Fourth year-----Timothy and clover (sometimes mixed with alfalfa or alsike, or both).

The grass is usually allowed to stand two years, the first crop of hay being largely clover, the second timothy. If left down three years the third crop is timothy, used either for hay or for pasture.

APPLICATION OF MANURE.

WHEN APPLIED AND CROPS AFFECTED.

The manure is hauled out twice a year on the majority of farms. That which accumulates during the fall and winter is applied to sod land which is to be broken for corn, to potatoes, and to ensilage corn if any is grown. That which accumulates during the spring and summer is hauled out and applied in July or August on oat stubble which is to be prepared for wheat.

There is an opinion among many farmers that for best results the sod should be manured and plowed in the fall. This is rarely done, however, in actual practice, because of the short time between fall seeding and freezing weather, since to accomplish this on most farms would necessitate the employment of extra teams and men, and the difference in results obtained between the fall and spring applications does not seem to justify this expense. Many apply the manure during the winter months when the ground is frozen and hauling is easier and more time available. Objection has been raised to this practice, as the manure applied on the frozen ground is apt to be washed off to a large extent when the snow melts and before the ground is sufficiently thawed out to allow the soluble material to sink in. This is especially true of hillside land. In general practice the sod is usually manured in the early spring at the rate of 8 to 10 tons per acre and is immediately plowed and rolled.

The second year of the rotation includes oats and potatoes, or, if there is a silo on the farm, ensilage corn. Sometimes soy beans are added. In any case the whole field is manured before the wheat, which will occupy the land the third year, is sown. The usual practice is to manure that portion of the corn-stubble land which is intended for potatoes and ensilage corn in the spring, the potato land receiving 12 to 15 tons per acre and the ensilage-corn land about 8 to 10 tons. When this is done the whole cornstalk field is immediately plowed and put into condition for planting. The portion occupied by oats is not manured until after the oats are harvested, the summer accumulation of manure being applied on the oat stubble in July and August at the rate of 8 to 10 tons per acre and double-disked in.

Thus the prevailing custom in this section is to apply manure twice during each cycle of the rotation. The rate of application ranges from 6 to 10 tons per acre with an average of about 9 tons per acre. This means that each acre in the rotation area receives from

12 to 20 tons of manure every five or six years, depending on whether the grass is left down two or three years.

If any manure is left over in the spring, it is applied as far as it will go to the permanent pasture. In this way every part of the permanent pasture receives an application of manure periodically, usually once in from 6 to 10 years.

Some farmers make only one application during the five or six years of the rotation. This is almost without exception applied to sod or corn at the rate of 12 to 15 tons per acre. There are also some farmers who do not allow manure to accumulate at all. In such cases the manure is hauled out every day, or whenever the spreader is full.

HAULING AND SPREADING.

The barnyard is so arranged that the team and spreader can be driven into any part of it, including the covered portion, where it can be loaded directly. The crew may consist of one team and two men, one man to drive the team and the other to help load, or it may have three men with two wagons or spreaders, two men loading while the third drives out to the field. Upon return to the barn the team is merely unhitched from the empty wagon and hitched to the loaded one.

Applying manure by hand is practiced to some extent. This method, however, is slower than the spreader and does not distribute the manure as evenly on the ground. It is also the practice in some sections, especially where manure spreaders are not in common use, to unload the manure from wagons in small piles to be scattered later. This, however, is not as effective as direct application, since leaching takes place and the uneven effect is greatly increased.

HOW MANURE IS UTILIZED ON TEN SUCCESSFUL FARMS.

Ten Chester County farms, upon each of which the yield of corn is maintained at 75 bushels or more per acre, were chosen as offering good examples of the way in which manure is utilized by farmers who follow the above-described method of saving it. The average yield of corn on these 10 farms was 85 bushels per acre. (See Table I, p. 3.) None of these farms are making high yields at the sacrifice of profit. It is known that each is financially successful.

The prevailing cropping system on these farms is similar to the general practice already described. The first year is corn; the second is either corn for grain, ensilage corn, potatoes, or some combination of one or more of these crops with oats (soy beans in one case); the third year is wheat, and the fourth year is grass, usually timothy and clover, sometimes mixed with alfalfa or alsike, or both. In one case alfalfa alone is used. In one case the rotation is corn for two years, wheat for one year, and alfalfa for three years.

The well-established practice of growing clover and other legumes in regular rotation, and the heavy applications of high-quality manure make the use of nitrogenous commercial fertilizers largely unnecessary. Phosphoric acid seems to be the principal element of plant food that is lacking to any extent, and this is supplied mostly in the form of acid phosphate.

The presence in this soil of feldspar rock in every stage of disintegration, and the fact that the farmers making the best yields are not using potash fertilizers to any extent, would indicate that the soil contains enough potash for present needs. Lime is used, or has been used, on all farms. Its effect, however, is not well marked on some farms, indicating no doubt that enough lime for the present has already been supplied.

The barnyard manure on these farms is practically all saved and is of very high quality. It is applied for the most part on sod, either as a top dressing for timothy or to be turned under for corn, and on ensilage corn and potatoes. The methods of application followed by each of these 10 farmers are given in detail in the following brief summaries of their individual farm operations.

FARM NO. 1.

Rotation area.—60 acres.

Area in permanent pasture.—40 acres.

Live stock.—Dairy cows, 6; heifers, 4; calves, 4; steers (6 months), 18; steers (all year), 5; horses, 6; colts, 3; sheep, 40. Total equivalent to 37.2 adult cows or horses, or 37.2 animal units.

Animal units per 100 acres in rotation.—62.

Sources of manure.—Barnyard manure, 210 tons. No manure bought.

Live-stock management.—The dairy stock is turned out to permanent pasture about April 15 to May 15, depending on the season, and remains until the latter part of November. The cows are in the stable only while they are being milked. The steers are bought in the fall and spend about two months on the pasture in the fall and about six weeks in the spring before they are sold. The sheep spend the day in the pasture, but are always kept in the pen at night. The rotation area is never pastured.

Permanent pasture.—The equivalent of 33 mature cows are pastured day and night for five or six months, or about one cow to 1.2 acres. Manured at the rate of 6 tons per acre once in 10 years. No fertilizer or lime.

Manure management.—The manure is kept in a large lot which is completely inclosed by a tight stone wall and about nine-tenths of which is under cover. All the manure and refuse from the stables and all straw and cornstalks not used in the stable roughage are collected in the covered portion, and it is here that the cattle spend their time when not in the stable or pasture. Perhaps nine-tenths of the manure is thus well tramped and dry. It is hauled out during midsummer, winter, or spring.

Manurial and cultural practices and yields.

First year: Corn. No manure or fertilizer.

Third-year sod is plowed up in the spring, 6 inches deep, immediately rolled, or dragged with a plank drag or clod masher, harrowed three times with a double-action cutaway, and rolled or dragged again. The seed, which was

selected in the field at husking time and which was kept in a warm dry room all winter, is reselected and planted thickly with a 2-row planter, run over with a weeder when the young plants have three or four leaves, cultivated four times during the growing season, the first time deep, and each of the others a little shallower than the last, and thinned to two stalks every 32 inches in the row.

Average yield, 85 to 90 bushels per acre.

Second year: Ensilage corn. Six tons of barnyard manure applied on cornstalk land during the previous winter and spring.

This land is then plowed 6 inches deep, rolled, disked three times, rolled again, or dragged with a plank drag or clod masher. The remaining treatment is the same as already described for corn, except that it is thinned to two stalks every 24 inches in the row.

Average yield, 10 to 15 tons per acre.

Third year: Wheat. Three hundred to 350 pounds of acid phosphate per acre at time of seedling.

Ensilage corn is cut about October 1 and the land immediately disked two or three times, then rolled or dragged. The wheat is drilled at the rate of 2 bushels per acre, and the land left rough for the winter.

Average yield, 25 to 30 bushels per acre.

Fourth year: Grass. Six tons of barnyard manure per acre on wheat stubble just before seeding.

As soon as the wheat crop is off, the stubble is disked 10 to 12 times with a double-action cutaway, run at different angles and followed by a plank drag. The grass mixture contains alfalfa (5 quarts), red clover (5 quarts), alsike clover (2½ quarts), and timothy (5 quarts), and is sown at the rate of 11 to 12 quarts per acre.

Average yield, 3 to 3½ tons per acre.

Fifth year: Grass. Six tons of barnyard manure on clover sod during the previous winter.

Average yield, 3 to 3½ tons per acre.

Sixth year: Grass. No manure or fertilizer.

Average yield, 2 tons per acre.

FARM NO. 2.

Area in rotation.—70 acres.

Permanent pasture.—18 acres.

Live stock.—Dairy cows, 18; helpers, 3; horses, 4. Total equivalent to 24 adult cows or horses, or 24 animal units.

Animal units per 100 acres in rotation.—34.

Sources of manure.—Farm, 210 tons; mushroom beds, 200 tons.¹

Live-stock management.—The dairy stock is turned out about May 5 to 10, and remains until about November 1 to 10. Corn is sown for silage during the dry period in July and August. The four horses spend the nights in the pasture during the season, also days when not at work.

¹ Large quantities of fresh horse manure are shipped into this locality from Philadelphia, New York, and other large cities for use in mushroom beds, mushroom growing being a profitable side line on many farms. Before being put into the beds it is piled up in ricks 4 or 5 feet high and turned frequently until it is very finely pulverized and in a high state of fermentation. It is then mixed with soil and put into the mushroom beds. By the time the crop is off the fermentation has practically exhausted itself and much of the nitrogen has been driven off. The manure is then most commonly used as a top dressing on grass. It is also used in compost with other manure of the farm.

Permanent pasture.—Two-thirds of the 18 acres of permanent pasture is subject to overflow, and is materially enriched thereby. In addition, 11 tons of mushroom manure is applied each year as a top dressing. This pasture carries 25 head of cattle all summer in ordinary seasons, an equivalent of 1.4 head per acre.

Manure management.—The manure from both horse and cow stables is thrown together into a specially-arranged lot, about one-third of which is covered and surrounded by a stone wall. In April all manure is piled up about 5 feet high to reduce as far as possible the loss by leaching. Manure is hauled out in August and September, if possible, because in the experience of this farmer it is twice as effective as when hauled in winter.

Manurial and cultural practices and yields.

First year: Corn. Manure is hauled out in August or September to second-year sod, 14 tons per acre.

Ground is plowed in spring 6 to 7 inches deep, immediately rolled, and harrowed three times with a spring-tooth, the first time lengthwise of the furrows, the second obliquely across, and the third at right angles to the second, each time the teeth being set a little deeper than the last. After planting, the field is rolled, harrowed, just after the corn is up, with a light spike-tooth harrow, the teeth slanting back. First cultivation, small teeth set next to row; second cultivation, medium-sized teeth next to the row, thinned; third cultivation same as second; fourth, with shovels next to row, thinned again to 15 or 17 inches in the row. Suckered July 1 to 10; cut when thoroughly ripe to avoid shrinkage. About three times as much seed corn as needed is selected when husking in the field and while hauling in the corn. It is further sorted during the winter—about four times.

Average yield, 100 bushels per acre.

Second year: Five-sevenths oats, two-sevenths potatoes. Ground plowed for oats in April when dry, immediately rolled, harrowed twice with a spring-tooth, and 400 to 450 pounds of acid phosphate applied per acre. Two and one-half bushels of oats sown per acre, drilled half one way and half the other, and rolled.

Average yield, 40 to 50 bushels per acre.

For potatoes the ground is plowed in April when the soil is dry; 1,500 pounds of acid phosphate being applied per acre, in every third furrow. The land is rolled immediately, harrowed, rolled, planted, and cross-harrowed with a spike-tooth, with the teeth slanting back, when the potatoes show through. The crop is cultivated four times during the growing season. Seed potatoes are usually bought each year.

Average yield, 60 bushels per acre.¹

Third year: Wheat. Oat stubble plowed July 20, harrowed every two weeks. Potato ground plowed about middle of September. Wheat sown 2½ bushels per acre, half one way and half the other, with 6 to 8 quarts of timothy per acre, and 450 pounds of acid phosphate per acre; harrowed and rolled.

Average yield, 30 bushels per acre.

Fourth year: Grass. No treatment.

Eight quarts red clover per acre sown in the spring.

¹ The yields of potatoes in the Chester loam are low as compared to those of other crops. The reason is not well understood and is now under investigation. The potatoes grown are for home use almost entirely, and are mentioned in this bulletin only because this crop occupies part of the land in the second year of the rotation on most farms, and the description would be incomplete without it.

Average yield, $2\frac{1}{2}$ tons per acre.

Fifth year: Grass. No treatment.

Average yield, 2 tons per acre.

FARM NO. 3.

Area in rotation.—96 acres.

Area in permanent pasture.—20 acres.

Live stock.—Dairy cows, 17; helpers, 5; calves, 5; horses, 4. Total equivalent to 26 adult cows or horses, or 26 animal units.

Animal units per 100 acres in rotation.—27.

Sources of manure.—Barnyard manure, 200 tons; no manure bought.

Live-stock management.—The cattle are turned out to permanent pasture about the first week in May and remain until about November 1. During that time they get no other feed except in dry years, when sweet corn is fed. The only time spent in the stable during this period is while the cows are being milked each day. The horses spend about $2\frac{1}{2}$ months on pasture. The rotation area is pastured about two months in the fall after the crops are off.

Permanent pasture.—No manure is applied except that dropped by the animals while in the fields. Nitrate of soda, 100 pounds, and acid phosphate, 100 pounds, are applied annually. In ordinary seasons this pasture supports about one head of stock per acre.

Manure management.—Eighty-five per cent of the manure is kept under cover and well tramped, and about 1 ton of land plaster is mixed with it during the year. It is turned two or three times during the year.

Manurial and cultural practices and yields.

First year: Corn. Manured in the fall at the rate of 8 tons of manure on sod. Three hundred pounds of $2\frac{1}{2}$ -8-1 fertilizer¹ per acre in the spring.

If possible the third-year sod is plowed in the fall. If plowed in the spring the land is immediately rolled, double-disked twice, harrowed first with a spring-tooth, then with a spike-tooth, and rolled again. Seed corn is selected in the field at husking time and kept in a dry place during the winter. It is reselected in the spring, the butts and tips removed, hand shelled, and run through a sorter. The corn is planted in drills, thickly, about May 20, and just before the corn comes up it is harrowed once or twice with a spike-tooth. Five or six cultivations are given during the growing season, the first two deep, the others shallow, and the corn thinned to 15 inches in the row.

Average yield, 75 bushels per acre.

Second year: Eight-elevenths ensilage corn, three-elevenths potatoes.

For corn: No manure. Four hundred pounds of acid phosphate per acre in the spring.

Cornstalk land is plowed in the spring 8 inches deep, rolled at once, harrowed three times with a spring-tooth, and the field finished with a plank drag or roller. The planting is done a little thicker than for grain, the after cultivation being the same. The stalks are thinned to 10 inches in the row.

Average yield, 11 tons per acre.

For potatoes: Manure is applied to cornstalk land at the rate of 8 tons per acre in the spring. Three hundred pounds of special potato fertilizer is used per acre, half applied before, and half after planting. In the spring the land is plowed 8 inches deep, rolled immediately, and harrowed with a spring-tooth three or four times, first lengthwise of the furrows, then across, sometimes diagonally. The land is then rolled, harrowed three times before the potatoes come up, and cultivated four or five times during the growing season.

¹ This fertilizer contains $2\frac{1}{2}$ per cent of nitrogen, 8 per cent of phosphoric acid, and 1 per cent of potash, and is known to the trade as " $2\frac{1}{2}$ -8-1 goods."

Third year: Wheat. No manure. Four hundred pounds of 2½-8-1 fertilizer per acre.

As soon as the ensilage corn and potatoes are off, the whole field is plowed, rolled, and harrowed three times with a spike-tooth. The seed wheat is thoroughly fanned, sown at the rate of 1¾ bushels per acre, and the land rolled.

Average yield, 28 to 30 bushels per acre.

Fourth year: Grass. No manure or fertilizer.

Six quarts of timothy sown with the wheat in the fall, and in the spring a mixture of red clover 3 quarts, alsike 1½ quarts, and alfalfa 1½ quarts per acre added.

Average yield, 3 to 3½ tons per acre.

Fifth year: Grass. No manure. One hundred pounds of acid phosphate and 100 pounds of nitrate of soda applied per acre.

Average yield, 2 tons per acre.

Sixth year: Grass. Barnyard manure at the rate of 8 tons per acre is applied in the spring; also 100 pounds of nitrate of soda and 100 pounds of acid phosphate per acre.

Average yield, 2 tons per acre.

FARM NO. 4.

Area in rotation.—125 acres.

Area in permanent pasture.—60 acres.

Live stock.—Dairy cows, 3; helpers, 1; steers, 35 (8 months); horses, 6; hogs, 50. Total equivalent to 42.5 adult cows or horses, or 42.5 animal units.

Animal units per 100 acres in rotation.—30.

Sources of manure.—Farm, 450 tons. No manure bought. No fertilizer.

Live-stock management.—All cattle are turned out to permanent pasture in May, the date depending on the weather conditions, and remain until the latter part of November. The rotation area is pastured after the crops are off, except where wheat has been sown.

Permanent pasture.—What manure is left after all the other crops are treated is put on the permanent pasture at the rate of 9 tons per acre. These applications are made at irregular periods and to the poorer spots. About 35 head of cattle are carried during the growing season, or about one animal to 1.7 acres.

Manure management.—The manure is kept in a lot about 80 feet square, surrounded by a stone wall, and about three-fourths covered. All manure from the stables is dumped into the covered part, where it is kept well tramped by the cattle, which run loose in the lot when not in the stable or pasture. The manure is hauled out during the winter.

Manurial and cultural practices and yields.

First year: Corn. No manure. Acid phosphate, 300 to 350 pounds per acre.

As much as possible of the second-year sod is plowed up in the fall and left rough during the winter. The remainder is plowed in the spring, disked twice, rolled, disked again, and rolled again if the land is lumpy, and crossed with a spring-tooth. Seed corn is selected from the heap after husking, and is all tested and graded before planting. Just before planting, the field is rolled once more, and just before the corn comes up, it is harrowed with a smoothing harrow. Three to four cultivations are given during the growing season.

Average yield, 90 bushels per acre.

Second year: One-fourth corn, one-fourth potatoes, and one-half oats.

For corn, 9 tons barnyard manure applied during the winter, and 400 pounds 16 per cent acid phosphate per acre.

Cornstalk land is plowed 9 to 11 inches deep in the spring, rolled the same day, disked once, and rolled again. Seed selection same as for the first year. After planting, the field is harrowed twice with a smoothing harrow, and three to four cultivations are given during the growing season.

Average yield, 75 bushels per acre.

For potatoes: Barnyard manure, 9 tons per acre, applied during the winter. Sixteen per cent acid phosphate applied at the rate of 1,000 pounds per acre.

The land is plowed in the spring 9 to 11 inches deep, rolled the same day, disked once, crossed with a spike-tooth harrow, and rolled. About 10 bushels are selected each year from strong prolific hills, to plant 1 acre, and the seed for the next year's crop is selected from this acre. After planting, and before the potatoes are up, the land is worked over two or three times with a spike-tooth. During the growing season three to four cultivations and three to four sprayings are given, both being contingent on weather conditions.

Average yield, 100 bushels per acre.

For oats: Sixteen per cent acid phosphate, applied at the rate of 250 to 300 pounds per acre at time of seeding.

Plowing is done in the spring, 9 to 11 inches deep, rolled same day, disked once, rolled, and seed sown at the rate of 2 bushels per acre, after which it is rolled again.

Average yield, 40 bushels per acre.

Third year: Wheat. Ground limestone is applied at the rate of 1 ton per acre after plowing and disking corn and oats stubble. Also 400 pounds of 16 per cent acid phosphate is applied per acre.

That portion of the field which has been in corn and oats is plowed as soon as possible in the fall, and the potato ground disked, after which the whole field is rolled. The corn and oats areas are double-disked and cross-harrowed with a spike-tooth, and the wheat sown at the rate of 2 bushels per acre, with 4 pounds of timothy and 1 pound of alfalfa. In the spring, 4 quarts of red clover and 2 quarts of alsike are added to the mixture.

Average yield, 25 bushels per acre.

Fourth year: Grass. No manure or fertilizer.

Average yield, 2½ tons per acre.

Fifth year: Grass. Barnyard manure, 9 tons per acre, applied during the winter.

Average yield, 1½ tons per acre.

FARM NO. 5.

Area in rotation.—90 acres.

Area in permanent pasture.—25 acres.

Live stock.—Dairy cows, 26; heifers, 7; calves, 3; horses, 5; colts, 1; hogs, 10.

Total equivalent to 38.5 adult cows or horses, or 38.5 animal units.

Animal units per 100 acres in rotation.—44.

Sources of manure.—Farm, 300 to 400 tons; mushroom beds, 50 to 75 tons.

Live stock management.—The cattle are turned out on the permanent pasture about May 15, and remain without other feed until about November 15. In the fall the stock spend about one-fourth of their time on the rotation area until taken off in November.

Permanent pasture.—The equivalent of 32 mature cows is pastured day and night between May 15 and November 15, or about 1.3 cows per acre. Manure is applied at irregular intervals, depending on the condition of the pasture. When necessary, both manure and fertilizer are applied.

Manure management.—The manure is kept in a large lot, mostly covered, and surrounded by a stone wall. All the manure from the stables is kept in the covered portion. The cattle run loose in this lot when not in the stable or pasture. The manure is hauled out during the winter.

Manurial and cultural practices and yields.

First year: Corn. Four hundred pounds of 16 per cent acid phosphate per acre.

As much as possible of the second-year sod is plowed up in the fall 5 inches deep, and left rough over winter. The remainder is plowed in spring and rolled at once. The whole field is then harrowed, rolled, disked four times, and followed by a spring-tooth and a clod masher. Corn for seed is selected from the pile in the field and kept in a dry place during the winter. A germination test is made before planting. Just as the corn is coming through, the field is run over with a weeder. Five cultivations are given during the growing season.

Average yield, 75 to 100 bushels per acre.

Second year: Three-fourths ensilage corn, one-fourth potatoes.

For corn: Barnyard manure, 8 tons per acre, applied on cornstalk land in the spring; 400 pounds of 2-8-8 fertilizer per acre.

The land is plowed 7 inches deep, rolled, disked once, harrowed with a spring-tooth, followed by the clod masher or roller, and planted and cultivated as already described for corn grown for grain.

Average yield, 20 tons per acre.

For potatoes: Barnyard manure is applied at the rate of 8 tons per acre, and the land plowed 7 inches deep, rolled, double-disked twice, harrowed with a spring-tooth, followed by roller or clod masher. When the potatoes are planted, 300 pounds of 2-14-0 potato fertilizer is applied in the row; 300 pounds more is broadcasted just before the potatoes come up, after which a cultivator is run lengthwise of the row, followed by a spike-tooth. Five or six cultivations are given during the growing season.

Average yield, 130 bushels per acre.

Third year: Wheat. Four hundred pounds of acid phosphate is applied per acre.

The corn land of the previous year is double-disked three times, and the potato land once. Wheat is sown at the rate of 1 to 2 bushels per acre, and rolled.

Average yield, 28 bushels per acre.

Fourth year: Grass. Barnyard manure, 8 tons per acre, applied in August, between diskings.

Wheat stubble is disked 12 times in August, smoothed with a plank drag, and the following mixture sown August 10 to 20: Red clover, 4 quarts; alfalfa, 4 quarts; timothy, 4 quarts. The seed is covered with a weeder and rolled.

Average yield, 2 tons per acre.

Fifth year: Grass. Barnyard manure is applied in the winter or spring at the rate of 8 tons per acre.

Average yield, 1.5 tons per acre.

FARM NO. 6.

Area in rotation.—54 acres.

Area in permanent pasture.—4 acres.

Live stock.—Dairy cows, 15; heifers, 8; horses, 3. Total equivalent to 22 adult cows or horses, or 22 animal units.

Animal units per 100 acres in rotation.—41.

Sources of manure.—Farm, 175 to 200 tons. No manure bought.

Live-stock management.—Cattle are turned on permanent pasture about May 1, and spend all of their time there for five or six months, except about two hours per day while the cows are being milked and fed. The third-year grass is pastured in conjunction with permanent pasture.

Permanent pasture.—This pasture has always been used in conjunction with other pastures, so that it has not been possible to determine its carrying capacity. It is, however, well cared for, and affords a large amount of grazing. Eight tons of manure are applied per acre every two years.

Manure management.—All manure is collected in a lot which is completely covered and surrounded by a stone wall, where the cattle exercise when not in the stable or pasture. The manure is therefore well tramped and free from leaching. Manure is hauled out in the spring or in July.

Manurial and cultural practices and yields.

First year: Corn. Barnyard manure is applied in the spring at the rate of 8 tons per acre; also 300 pounds of bone meal per acre.

Third-year grassland is plowed 7 to 8 inches deep, immediately rolled, disked three times, and rolled again. Seed corn with perfect ears and deep grains is selected at husking time and put in dry place for winter; reselected in spring. During the growing season the corn is cultivated each week or after each rain. Plenty of seed is used, and the corn is thinned to 2 stalks every 32 inches in the row.

Average yield, 80 bushels per acre.

Second year: One-half oats, one-half potatoes.

For oats: Acid phosphate is applied at the rate of 300 pounds per acre.

One-half of the cornstalk land is plowed 5 or 6 inches deep, harrowed once or twice, and rolled. Oats are sown at the rate of $2\frac{1}{2}$ bushels per acre.

Average yield, 50 bushels per acre.

For potatoes: Barnyard manure, 10 to 12 tons per acre, applied in the spring. Also special potato fertilizer, 3-8-10, applied at the rate of 700 pounds per acre.

The other half of the cornstalk land is plowed 7 inches deep and immediately rolled. The cutaway is used until the land is in good condition. The land is then rolled, planted, and finished with a spike-tooth harrow. Smooth potatoes for seed are selected in the fall. During the growing season the potatoes are cultivated each week or after each rain.

Average yield, 200 bushels per acre.

Third year: Wheat. Barnyard manure at the rate of 9 tons per acre is applied on oat stubble in the fall. Lime is applied just before seedling at the rate of 800 to 1,000 pounds per acre, also 300 pounds of bone meal, and 300 pounds of acid phosphate per acre.

Oats stubble is plowed, harrowed, rolled, and sown at the rate of $1\frac{1}{4}$ to 2 bushels per acre.

Average yield, 36 bushels per acre.

Fourth year: Grass. No manure or fertilizer. Sometimes 300 pounds of bone meal.

Eight quarts of timothy are sown with the wheat in the fall, and in the spring $3\frac{1}{2}$ quarts of red clover and $3\frac{1}{2}$ quarts of alsike are added.

Average yield, 3 tons per acre.

Fifth year: Grass. No manure or fertilizer.

Average yield, 3 tons per acre.

Sixth year: Grass (pasture). No manure or fertilizer.

FARM NO. 7.

Area in rotation.—100 acres.

Area in permanent pasture.—30 acres.

Live stock.—Dairy cows, 30; bulls, 1; heifers, 15; calves, 5; horses, 8; colts, 1; hogs, 5. Total equivalent to 50.5 adult cows or horses, or 50.5 animal units.

Animal units per 100 acres in rotation.—50.5.

Sources of manure.—Farm, 400 tons; mushroom beds, 50 tons.

Live-stock management.—Cattle are turned on permanent pasture about May 5, and get nothing else until about July 1, when the pasture is supplemented with the second-crop clover during the period when pastures are short. The horses are turned out at night until after harvest, when they spend all idle time on the pasture. Hogs have the run of the pasture during the entire season.

Permanent pasture.—A 10-acre area of low land subject to overflow receives no treatment. A 10-acre area of low land not subject to overflow receives an application of barnyard manure every three or four years at the rate of 6 tons per acre. A 10-acre area of hillside is limed every eight or nine years and top-dressed every three years with mushroom manure at the rate of 6 tons per acre. Carrying capacity, 1 cow per acre without other feed from May 15 to July 1.

Manure management.—All roughage is saved, including corn fodder, which is run through a cutter. This process improves it, both as a bedding and as an absorbent for liquid manure, and makes it easier to handle. About nine-tenths of the manure is made under cover, where it is free from leaching, and where it is well trampled during the winter.

Manurial and cultural practices and yields.

First year: Corn. No treatment.

Second-year sod is plowed in the spring 4 to 5 inches deep; if done early, it is left rough until time to plant; if done late, it is rolled at once, harrowed twice—on heavy soils with the disk, on light soils with the spring-tooth—and rolled again. Seed corn is selected at husking time, dried and kept in a warm place during the winter. Before planting germination tests are made and the tips and butts discarded, except for ensilage corn. The corn is planted shallow, 3 grains to the hill, $3\frac{1}{2}$ feet apart in the row, and cultivated four times during the season. Rye and rape are sown on steeper hillsides to prevent washing and to improve the soil.

Average yield, 80 bushels per acre.

Second year: Ensilage corn, soy beans, and potatoes. That portion of the cornstalk land intended for ensilage corn and soy beans, about 17/20 of the whole field, is manured during the winter at the rate of 6 to 9 tons per acre, and about 250 pounds of 16 per cent acid phosphate and 100 pounds of tankage are added in the spring. The remainder, for potatoes, receives 12 tons of manure per acre and about 300 pounds of 16 per cent acid phosphate, 100 pounds of tankage, and 50 pounds of nitrate of soda.

For corn: Old cornstalks are dragged down with a railroad iron, and the land is plowed about May 1, harrowed twice with a spring-tooth, and rolled (or if the land is heavy, disked once and harrowed once with a spring-tooth), planted with drill, harrowed with spike-tooth until corn is too tall, and cultivated four times. For seven years in succession ensilage corn has been grown on the same land on this farm and the yield maintained by growing crimson clover which was pastured each spring before plowing for corn.

Average yield, 12 tons per acre.

For soy beans: Cornstalk land is dragged as for ensilage corn, and is plowed at the same time, harrowed frequently until about June 8, and planted.

For potatoes: Land is plowed 6 to 7 inches deep, double-disked, harrowed once with spring-tooth, rolled, and planted 3 inches deep. In selecting potatoes for seed, a certain size is sought, which will make four good-sized pieces when cut. The size desired comes between what is regarded as fancy and seconds. The land is rolled after planting, harrowed three times with spike-tooth after the potatoes are up about 3 inches, and cultivated three to four times during the growing season.

Average yield, 100 bushels per acre.

Third year: Wheat. Two hundred pounds of acid phosphate and 150 pounds of tankage per acre.

Ensilage-corn and soy-bean stubble are double-disked into good seed bed without plowing, rolled, and wheat sown at the rate of 2 bushels per acre. Sometimes corn follows corn on those spots where rye and rape have been sown the year before and plowed under.

Average yield, 30 bushels per acre.

Fourth year: Grass. Manure applied per acre, 6 tons; lime, 1 ton; acid phosphate, 200 pounds.

That portion of the field not already in grass is double-disked four times after the first rain, and the seed sown.

Average yield, 2 tons per acre.

Fifth year: Grass. No treatment.

Average yield, 2 tons per acre.

FARM NO. 8.

Area in rotation.—40 acres.

Area in permanent pasture.—18 acres.

Live stock.—Dairy cows, 5; helpers, 4; horses, 5; hogs, 10. Total equivalent to 14 adult cows or horses or 14 animal units.

Animal units per 100 acres in rotation.—35.

Sources of manure.—Farm, 70 tons; mushroom beds, 250 tons.

Live-stock management.—The cattle are turned into the permanent pasture about May 1, and spend all their time there, except when the cows are being milked, until December 1. The rotation area is not pastured, as a rule.

Permanent pasture.—The permanent pasture occupies creek-bottom land, and no special care is taken of it. No estimate could be obtained of its carrying capacity.

Manure management.—The manure is kept in a partly covered yard, and closed in by a wooden fence. The fence is soon to be replaced by a stone wall. The mushroom manure is hauled directly from the mushroom house to the field without further treatment.

Manurial and cultural practices and yields.

First year: Corn. Mushroom and barnyard manure in the proportion of 4 to 1 are applied at the rate of 18 tons per acre on second-year sod during the winter.

Land is plowed 5 inches deep in April, rolled at once, harrowed with the spring-tooth lengthwise of the furrow, crossed with the same implement, rolled again, planted, and harrowed with the spike-tooth with teeth slanting back when the corn is up about an inch. The corn is cultivated four times during the growing season.

Average yield, 90 bushels per acre.

Second year: Potatoes. Mushroom manure is applied at the rate of 18 tons per acre during the winter on cornstalk land.

The land is plowed in the spring, rolled at once, harrowed three times with a spike-tooth, rolled again, planted, harrowed when the potatoes are up about an inch, and cultivated three times. The crop is hoed finally about July 15.

Average yield, 150 bushels per acre.

Third year: Wheat. Mushroom manure is applied at the rate of 18 tons per acre on potato land in September.

The land is plowed 5 inches deep in September, rolled, and harrowed with the spring-tooth. Wheat is drilled at the rate of $1\frac{1}{2}$ bushels per acre with 7 quarts of timothy per acre.

Average yield, 30 bushels per acre.

Fourth year: Grass. Mushroom manure and barnyard manure, in the proportion of 4 to 1, applied in July and August at the rate of 10 tons per acre. Six quarts red clover seed per acre sown in the spring.

Average yield, $2\frac{1}{2}$ tons per acre.

Fifth year: No treatment.

Average yield, 2 tons per acre.

FARM NO. 9.

Area in rotation.—70 acres.

Area in permanent pasture.—20 acres.

Live stock.—Dairy cows, 18; helpers, 10; horses, 4; hogs, 60. Total equivalent to 39 adult cows or horses or 39 animal units.

Animal units per 100 acres in rotation.—56.

Sources of manure.—Farm, 100 tons; mushroom beds, 125 tons.

Live-stock management.—The cattle run on permanent pasture from about April 15 to November 1, without other feed. The horses also run out at night. It is estimated that for about two months in the fall the stock are on the rotation area about one-fourth of the time.

Permanent pasture.—The permanent pasture is limed every five years with 1,200 pounds of hydrated lime and manured at the rate of 12 tons per acre every five years. Occasionally lime, slag, and acid phosphate are used when it is thought advisable. The equivalent of 28 grown cows are carried for five or six months, or about 1.5 head per acre.

Manure management.—The manure is kept in a manure yard surrounded by a board fence. About half of it is the ground floor of the barn, and the manure from the stables accumulates in the covered portion. The wheat straw is used abundantly in the uncovered portion, but there is considerable leaching from this. This farmer mentioned the higher quality of the manure made under cover.

Manurial and cultural practices and yields.

First year: Corn. Six hundred pounds 2-8-1 fertilizer per acre.

Second-year sod is plowed in the spring, rolled once, harrowed with the spring-tooth or cutaway 3 or 4 times, or until a good seed bed is made, and rolled again. Seed corn is selected in the fall at husking time and reselected in the spring. Before planting, the seed is hand-shelled, the butts and tips being discarded. Corn is planted in rows 3 feet 6 inches apart, and a grain every 14 inches in the row, harrowed with a spike-tooth each way when the corn starts up, and cultivated five times during the growing season.

Average yield, 85 bushels per acre.

Second year: Potatoes. No treatment.

The land is plowed 9 to 10 inches deep in the spring, rolled at once, worked into a good seed bed with a spring-tooth or cutaway, rolled, planted in rows 30 inches apart, dropping one piece to every 12 inches in the row,

rolled, harrowed with the spike-tooth, the teeth set back, when the potatoes are coming up, and cultivated about five times.

Average yield, 140 bushels per acre.

Third year: Wheat. Six hundred pounds 2-8-1 fertilizer applied per acre when seedling.

The land is plowed 4 to 5 inches deep in August, if season is favorable, rolled, allowed to lie idle until the last week in September, harrowed with the sprug-tooth once or twice as may be necessary, or harrowed with the cut-away twice, 2½ inches deep, harrowed with smoothing harrow, and rolled. The seed wheat is changed every five years. Wheat is drilled at the rate of 1½ bushels per acre about the last week in September and the land left rough for the winter.

Average yield, 32 bushels per acre. The wheat this year (1917) averaged 31 bushels per acre, one field of 2 acres made 42 bushels per acre, and 2 acres of new seed made 47 bushels per acre.

Fourth year: Grass. No treatment.

Six quarts of timothy per acre is sown with the wheat in the fall, and in the spring red clover 4 quarts, and alsike 1½ quarts per acre are added.

Average yield, 2 tons per acre.

Fifth year: Grass. Twelve tons manure per acre applied in winter or spring.

Average yield, 2 tons per acre.

FARM NO. 10.

Area in rotation.—Sixty-three acres.

Area in permanent pasture.—Twenty-five acres.

Live stock.—Dairy cows, 10; heifers, 9; horses, 8; sheep, 35; hogs, 100. Total equivalent to 47.5 adult cows or horses, or 47.5 animal units.

Animal units per 100 acres in rotation.—74.6

Sources of manure.—Farm, 100 tons. No manure bought.

Live-stock management.—The cattle and sheep are turned into the permanent pasture about May 1, and remain until December 1, without other feed. Horses run out at night from June 1, to November 1. The hogs run loose all the time, and seven months of the year they are on alfalfa.

Permanent pasture.—The permanent pasture on this farm received no special treatment. At irregular periods small applications of barnyard manure are given with what is left over after the rotation crops have been supplied.

Manure management.—The manure on this farm accumulates in the basement of the barn, where the horses, sheep, and cattle are fed and run loose in separate pens. It is perfectly dry and well tramped, and there is little or no loss from leaching.

Manurial and cultural practices and yields.

First year: Corn. No manure is used. Three hundred and fifty pounds of acid phosphate applied per acre.

Alfalfa sod is plowed in the fall 7 or 8 inches deep, left rough through the winter, dragged in the spring, and disked four times. Seed corn is very carefully selected in the field before husking, and hung up in a dry place for the winter. In the spring this is reselected and tested before planting. After planting, the ground is harrowed, and during the growing season it is cultivated three times.

Average yield, 90 bushels per acre.

Second year: Corn. Cornstalk land is manured during the winter or spring at the rate of 11 tons per acre.

Land is plowed 7 to 8 inches deep, rolled at once, and treated as described for first-year corn.

Average yield, 80 bushels per acre.

Third year: Wheat. Three hundred pounds of acid phosphate applied per acre.

Second-year cornstalk land is disked without plowing, and sown to wheat at the rate of 2 bushels per acre.

Average yield, 30 bushels per acre.

Fourth year: Alfalfa. Two tons of ground limestone and 300 pounds of acid phosphate are applied per acre.

Wheat stubble is plowed about July 4, ground worked until August, alfalfa seed sown in August at the rate of 18 to 20 pounds per acre; harrowed lightly.

Average yield, 4.5 tons per acre.

Fifth year: Alfalfa. No treatment.

Average yield, 5 tons; three cuttings.

Sixth year: Alfalfa. No treatment.

Pastured with hogs.

